ABSTRACT FOR SPRING 1995 MRS MEETING

Submitted to Symposium G
Symposium Title: Structure and Properties of Multilayered Thin Films

CU - 304 SS MULTILAYERS: SYNTHESIS, STRUCTURE, MECHANICAL PROPERTIES AND STABILITY, T. W. Barbee, Jr., M. A. Wall and T. Weihs, Lawrence Livermore National Laboratory, Livermore CA 94550, S. P. Baker, Max-Planck-Inst Metall, Stuttgart, Germany, W. D. Nix, Stanford University, Stanford CA, 94305 and K. Parvin, San Jose State University, San Jose CA, 95152

Copper - 304 Stainless Steel (Cu/304SS) multilayers having periods of 0.8 nm to 100 nm thicker than 25 μm were synthesized using magnetron sputter deposition. TEM, XRD, DSC, hardness and tensile tests characterizations were made. The observed hardness of the Cu/304SS structures demonstrated that their mechanical properties are dependent on the structure of the individual layers as well as the scale of the layering imposed during synthesis. It was found that the 304 SS has a metastable BCC structure when deposited as a single film. In small period multilayer structures (< 7.5 nm) the 304 SS was almost wholly FCC. As the period of the multilayer was increased a significant volume fraction of metastable BCC 304 SS was formed. This resulted in hardness increasing with multilayer period rather than decreasing. This 304 SS transformation (FCC to BCC) can also occur through annealing. Both Fe and Cr are insoluble in Cu while Ni is soluble. Therefor, annealing will result in the diffusion of the Ni from the 304 SS to the Cu so that a Fe/Cr layer is formed that will have a BCC structure. This results in an increased hardness with annealing and magnetic effects as reported elsewhere at this conference. We report on the correlation of hardness/annealing/individual layer structure in these Cu/304SS multilayers in this paper. The implications of these observations for multilayer structure design and their thermal processing response are discussed.

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